DEPARTMENT OF NATIONAL DEFENCE
CANADA

OPERATIONAL RESEARCH DIVISION

DIRECTORATE OF OPERATIONAL RESEARCH
(CORPORATE, AIR, MARITIME)

PERSONNEL OPERATIONAL RESEARCH TEAM
in the
DIRECTORATE OF STRATEGIC HUMAN RESOURCE COORDINATION

DOR(CAM) RESEARCH NOTE RN 9913

A COMPARATIVE ANALYSIS OF ATTRITION RATES IN THE RADIO AND TELETYPE OPERATOR OCCUPATIONS BY RANK AND GENDER

By

Dr. A. Jesion
and
M. Winiszewska

August 1999

OTTAWA, CANADA

National Defence Défense nationale

Operational Research and Analysis

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Operational Research
(Corporate, Air, Maritime)

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OTTAWA, CANADA

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ABSTRACT

The Teletype Operator (TEL OP) Occupation is scheduled to be deleted by 31 March 2003 with personnel in this occupation encouraged to take an occupational transfer to the Radio Operator (RAD OP) occupation. The Personnel Operational Research Team (PORT) has developed a career flow model of the RAD OP occupation that takes into account both current population demographics and proposed policy changes. Attrition rates for use in this model were based on the "worst case" assumption that the "higher" historical attrition rates of RAD OP would apply. This paper documents a statistical analysis of historical attrition rates according to rank, years of service and gender for the RAD OP and TEL OP occupations.

A careful analysis of the available historical data has revealed a complex relationship between attrition rates in these two occupations. When the data are all grouped together, little can be concluded because underlying patterns are obscured. It can be demonstrated that historical attrition rates for the RAD OP occupation are "higher" than for the TEL OP occupation, but this effect is concentrated at the lower ranks and experience levels. At ranks above Master Corporal, TEL OP attrition rates are higher. Also, a number of gender-based attrition comparisons have been made within the TEL OP occupation as it has significantly more female members than the RAD OP occupation. Here, it is shown that historical attrition rates for male and female members are not significantly different, except at the lower ranks and experience levels where female attrition rates are higher.

RÉSUMÉ

Le groupe professionnel militaire d'opérateur de téléimprimeur (OP TI) devrait être aboli d'ici le 31 mars 2003 et le personnel encouragé au reclassement dans le groupe professionnel militaire d'opérateur de radio (OP RAD). L'Équipe de recherche opérationnelle du personnel (EROP) a développé un modèle sur les mouvements de carrières au sein du groupe professionnel OP RAD et qui tient compte des données démographiques actuelles ainsi que des changements proposés à la politique. Les taux d'attrition utilisés dans le modèle sont établis selon l'hypothèse «de la pire éventualité», c'est-à-dire selon des taux d'attrition les plus élevés de l'histoire du OP RAD. Le présent document comprend une analyse statistique et historique des taux d'attrition suivant le grade, les années de service et le genre au sein des groupes professionnels OP RAD et OP TI.

Une analyse attentive des données historiques disponibles met en lumière les liens complexes qui existent entre les taux d'attrition de ces deux groupes professionnels. Quand les données sont regroupées, presque rien n'en ressort parce que les modèles sous-jacents sont cachés. Il est possible de démontrer que le taux d'attrition historiquement dans le groupe OP RAD est plus élevé que celui du groupe OP TI, mais seulement pour les grades et niveaux d'expérience moins élevés. Au sein des grades supérieurs à celui de caporal-chef, les taux d'attrition du groupe OP TI sont plus élevés. De plus, on a comparé les taux d'attrition en fonction du sexe puisque le groupe OP TI compte beaucoup plus de femmes que le groupe OP RAD. Les résultats montrent que les taux d'attrition historiquement varient peu entre les hommes et les femmes, sauf pour les grades et niveaux d'expérience moins élevés où le taux d'attrition des femmes est plus élevé.

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A COMPARATIVE ANALYSIS OF ATTRITION RATES IN THE RADIO AND TELETYPE OPERATOR OCCUPATIONS BY RANK AND GENDER

I. INTRODUCTION

Background

1. The advent of new technology has led Communications and Electronics (C & E) Human Resource (HR) planners to recommend that the Teletype Operator (TEL OP) occupation be deleted by 31 March 2003. [1] Personnel in this occupation are being encouraged to take an occupational transfer to the Radio Operator (RAD OP) occupation. Non-commissioned members (NCMs) who are in these occupations are responsible for the operation of various types of C & E equipment and have some similarities in the way in which their respective military occupations (MOCs) are managed.

2. The TEL OP occupation (MOC 212) has considerably greater numbers of females in its population than the RAD OP occupation (MOC 211). As attrition rates for female personnel are often higher than the corresponding male attrition rates in the Canadian Forces (CF), it might be inferred that attrition rates for TEL OP would be higher than for RAD OP. However, an examination of the historical data reveal that total attrition rates for the RAD OP occupation are in fact greater than for TEL OP in most cases. This is due in large measure to the harsher working conditions associated with the RAD OP occupation.

3. The Personnel Operational Research Team (PORT) is providing analytical support to staff of the Assistant Deputy Minister Human Resources - Military (ADM HR-Mil) for the preparation of an Occupational Structure Implementation Plan (OSIP) for the "new" RAD OP MOC. In support of this process, PORT staff have developed a HR model of the RAD OP MOC which takes into account both the current demographic of the "combined" occupation and proposed changes to the MOC. Attrition rates for use in this model were based on the "worst case" assumption that the "higher" historical attrition rates of RAD OP would apply.

Aim

4. The aim of this paper is to determine whether or not observed differences in historical attrition rates for the RAD OP and TEL OP occupations are statistically significant.

5. The results from this type of analysis will be used for the development of attrition rates to be used in future RAD OP career flow models. Furthermore, the "lessons learned" from this analysis may be applied to similar studies being carried out by PORT analysts for other clients. As a result of CF re-engineering, new occupations are being proposed and approved at an unusual pace and modelling such proposals has become a major activity within PORT.

Scope

6. The analysis is based on attrition data contained in the PORT strategic desktop computer database [2] covering the period from 1982 to 1996 together with new information obtained from a recent Peoplesoft "datamart" NCM release download for 1996 to 1999.

Caveat

7. The PORT attrition database is a research resource and is not connected to any administrative functions in the CF. This database is not guaranteed to be completely accurate, although great pains have been taken to clean up spurious and inconsistent data entries. The authors believe that the error rate in the raw data discussed in this paper is below 2%. For example, the worst case for missing gender data was 1982 where unavailable information accounts for 0.9% (RAD OP) and 1.6% (TEL OP) of the available records.

II. ANALYSIS METHODOLOGY

Data Structure

8. For this analysis a new database was designed using MS Access. It combines data from the existing PORT NCM database and a new NCM release download from the "datamart". The results consist of strength, number of releases and the resulting attrition rate organized by MOC, Rank, Gender and Years of Service (YOS) for each year in the range from 1982 to 1998.

9. There was no gender identification for a total of thirty-three individuals in both MOCs 211 and 212 in the source databases. Since all the individuals appeared in the NCM database just once, it was not possible to assign the correct gender based on the data available. Hence, for the gender analysis only, these individuals were omitted.

10. The current Preferred Manning Levels (PMLs) for the RAD OP and TEL OP occupations are shown in Table I. [3] "Snapshots" of the population sizes for each MOC are given in Annex A for April of each calendar year between 1982 to 1998. As population size is small in some ranks for statistical testing, these have been aggregated as shown in Table II. (It should be noted that whenever maritime ranks appeared in the database, they were included in the equivalent Land Force rank grouping.)

Table I

Preferred Manning Levels (FY 1999/2000)

MOC	CWO	MWO	WO	SGT	MCPL	CPL PTE
RAD OP	18	32	80	137	328	619
TEL OP	7	10	24	80	99	300

Table II

Rank Groupings

Actual Ranks	Rank Group
Corporal (CPL) Private (PTE) – Recruit, Trained and Basic	CPL
Master Corporal (MCPL)	MCPL
Sergeant (SGT)	SGT
Warrant Officer (WO)	WO
Master Warrant Officer (MWO) Chief Warrant Officer (CWO)	Other

11. The information from the MS Access tables was analyzed using MS Excel. Two parallel methods of analyzing data were used. In the first method, attrition rates were calculated for each calendar year, as the sum of all releases (combining all YOS) in each Rank/MOC/Gender Group divided by the sum of the strengths (for all YOS) in that group. This method is called "by Year" in the analysis which follows. In the second method, attrition rates were obtained for specific YOS, as an average of all attrition rates that were observed in years 1982-1998 for each Rank/MOC/Gender/YOS Group. This second method will be referred to as "by YOS".

12. The following group nomenclature is used in this paper:

a. All_211_All: all data for MOC 211;

b. All_212_All: all data for MOC 212;

c. All_211_M: all data for male personnel in MOC 211;

d. All_211_F: all data for female personnel in MOC 211;

e. All_212_M: all data for male personnel in MOC 212;

f. All_212_F: all data for female personnel in MOC 212;

g. CPL_211_M: all data for male Corporals in MOC 211 (including personnel at the Private rank);

h. CPL_211_F: all data for female Corporals in MOC 211 (including personnel at the Private rank);

i. CPL_212_M: all data for male Corporals in MOC 212 (including personnel at the Private rank);

j. CPL_212_F: all data for female Corporals in MOC 212 (including personnel at the Private rank);

k. MCPL_211_M: all data for male Master Corporals in MOC 211;

l. MCPL_211_F: all data for male Master Corporals in MOC 211;

etc.

13. Attrition rates were paired within categories of interest with one or more population characteristics in common (e.g. CPL_211_M and CPL_212_M). Next, a set of differences was formed (e.g. the attrition rate for each calendar year for CPL_211_M minus the corresponding attrition rate for CPL_211_M). In some circumstances where no attrition rate was observed as a result of zero population(s), the difference was not counted. With the null hypothesis that the mean difference is not statistically different from zero, tests were carried out using the Statistical Analysis System (SAS) on a standard desktop computer.

14. It was observed that the average attrition rates posses large variability at very high YOS values due to low populations. Including these distorted rates in the data sets largely affects the results of the "by YOS" analysis. To avoid such misrepresentation, new data sets with the high YOS attrition rates omitted were created and used in the "by YOS" analysis as well. (The observed historical attrition rates for YOS < 19 had the lowest variability.)

Statistical Analysis

15. Annex B describes the statistical tests employed in this paper together with the results obtained by applying these tests to the historical attrition rates observed in the RAD OP and TEL OP occupations.

III. RESULTS

Average Attrition Rates of All_211_All and All_212_All

16. Figure 1 shows the historical attrition rates for all members of the RAD OP (MOC 211) and TEL OP (MOC 212) occupations for calendar years 1982 to 1998. It should be noted that both occupations were subject to the Forces Reduction Program (FRP) in 1994, resulting in a higher attrition rate for 1994 and 1995 (due to "spill over" from the fiscal year into the next calendar year). Statistical tests described in Annex B were applied to this data. However, the results are not significant enough to reject the hypothesis that these two sets of attrition rates have a mean difference of zero. If the 1994 and 1995 data points are removed, the hypothesis that the two sets of attrition rates have a mean difference of zero can be rejected (i.e. the RAD OP attrition exceeds TEL OP attrition).

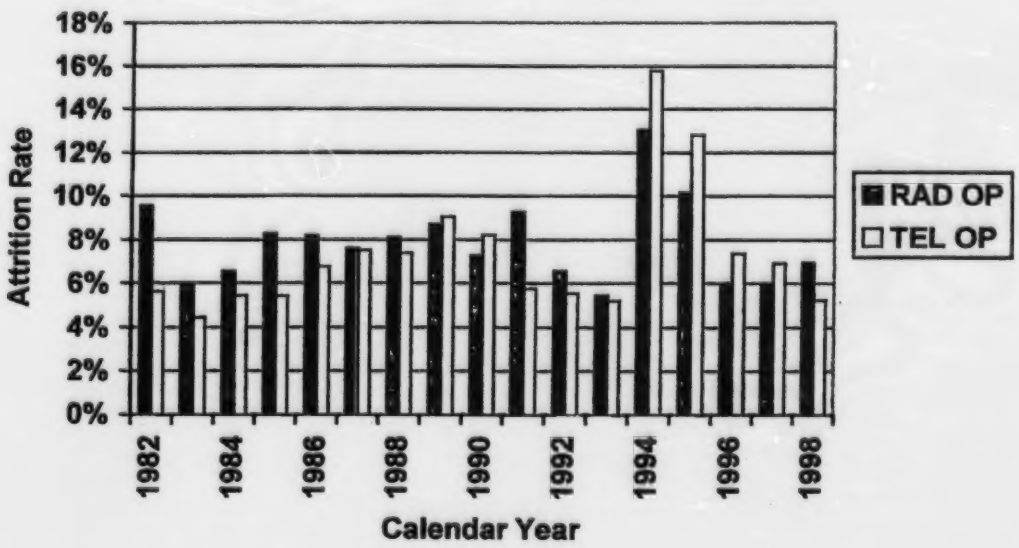

Figure 1: Average Attrition Rates by Year for all Personnel RAD OP (MOC 211) and TEL OP (MOC 212)

17. Figure 2 shows the historical attrition rates by Years of Service for all members of the RAD OP (MOC 211) and TEL OP (MOC 212) occupations. It can be observed that attrition rates are relatively stable for 3 < YOS < 19. RAD OP attrition is higher at the very lowest experience levels while TEL OP attrition is often higher at the other end of the spectrum. Attrition variability is high above 20 YOS because of low population sizes. Statistical tests described in Annex B were also applied to this data. As in the case of the "by Year" analysis, the results are not significant enough to reject the hypothesis that these two sets of attrition rates have a mean difference of zero. Also, if "FRP data" from the calendar years 1994 and 1995 data points are removed, the hypothesis that the two sets of attrition rates have a mean difference of zero can be rejected (i.e. the RAD OP attrition exceeds TEL OP attrition). The same tests have been applied to the subset of this data for YOS < 19 with no change in this conclusion.

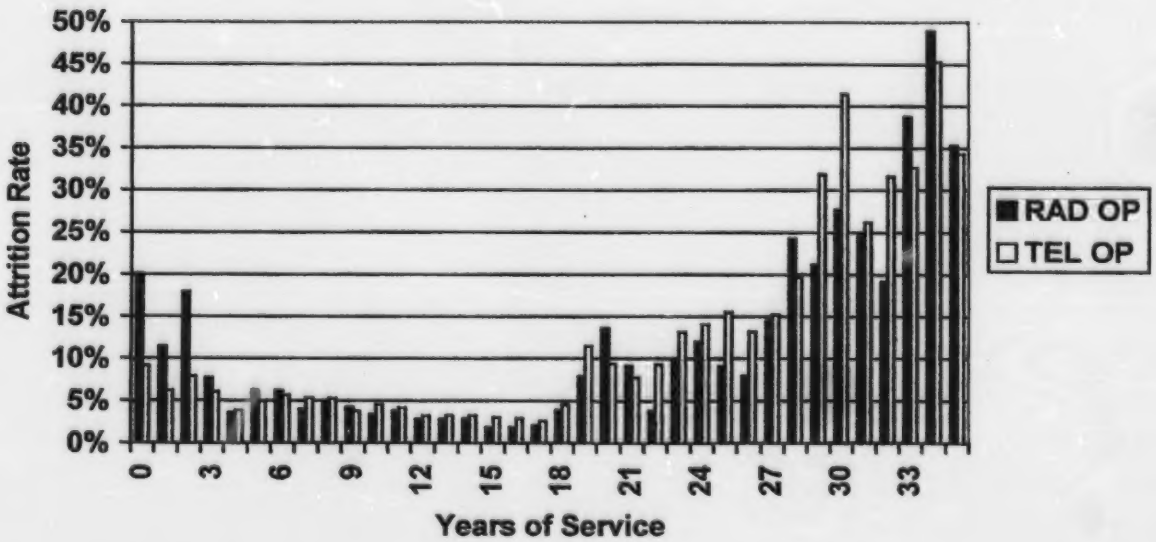

Figure 2: Average Attrition Rates by YOS for all Personnel RAD OP (MOC 211) and TEL OP (MOC 212)

Average Attrition Rates of All_211_M and All_212_M

18. Figure 3 shows the historical attrition rates for all male members of the RAD OP (MOC 211) and TEL OP (MOC 212) occupations for calendar years 1982 to 1998. The effect of the FRP can be seen in 1994 and 1995. Statistical tests described in Annex B were applied to this data. However, the results are not significant enough to reject the hypothesis that these two sets of attrition rates have a mean difference of zero. If the 1994 and 1995 data points are removed, the same conclusion is obtained (i.e. the RAD OP attrition rates for male personnel are not significantly different from TEL OP attrition rates for male personnel – when the analysis is done by calendar year).

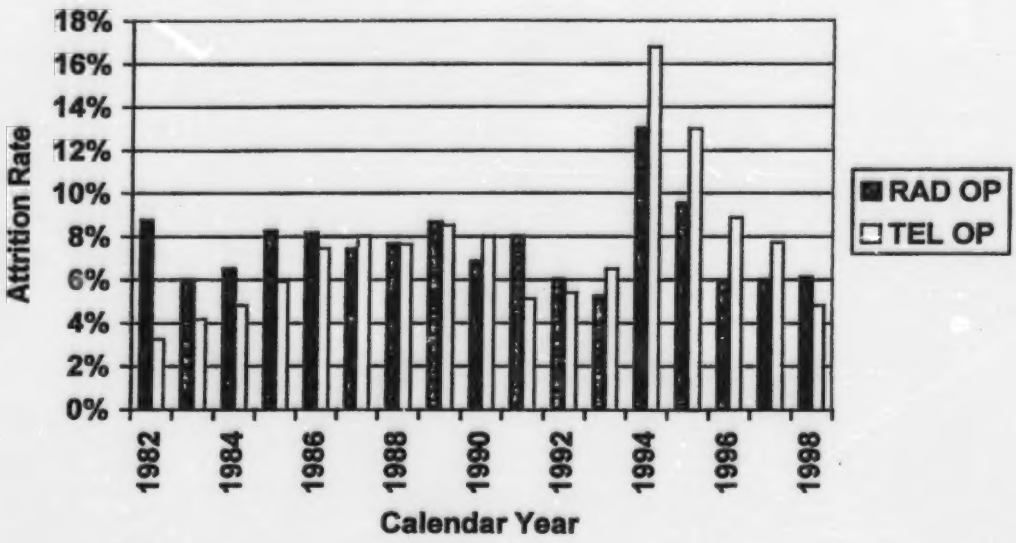

Figure 3: Average Attrition Rates by Year for all Male Personnel RAD OP (MOC 211) and TEL OP (MOC 212)

19. Figure 4 shows the historical attrition rates by Years of Service for all male members of the RAD OP (MOC 211) and TEL OP (MOC 212) occupations. Since the RAD OP occupation is predominantly male, there is no significant change for this MOC from Figure 2. RAD OP attrition is higher at the very lowest experience levels, reflecting the harsher working conditions of this occupation. Attrition variability is high above 20 YOS because of low population sizes. Statistical tests described in Annex B were also applied to this data. As in the case of the "by Year" analysis, the results are not significant enough to reject the hypothesis that these two sets of attrition rates have a mean difference of zero. If "FRP data" from the calendar years 1994 and 1995 data points are removed, there is no change in this conclusion. However, if the tests are applied to the data for YOS < 19 (with or without the FRP data), the hypothesis that the two sets of attrition rates have a mean difference of zero can be rejected (i.e. RAD OP attrition rates for male personnel exceed TEL OP attrition rates for male personnel for YOS < 19).

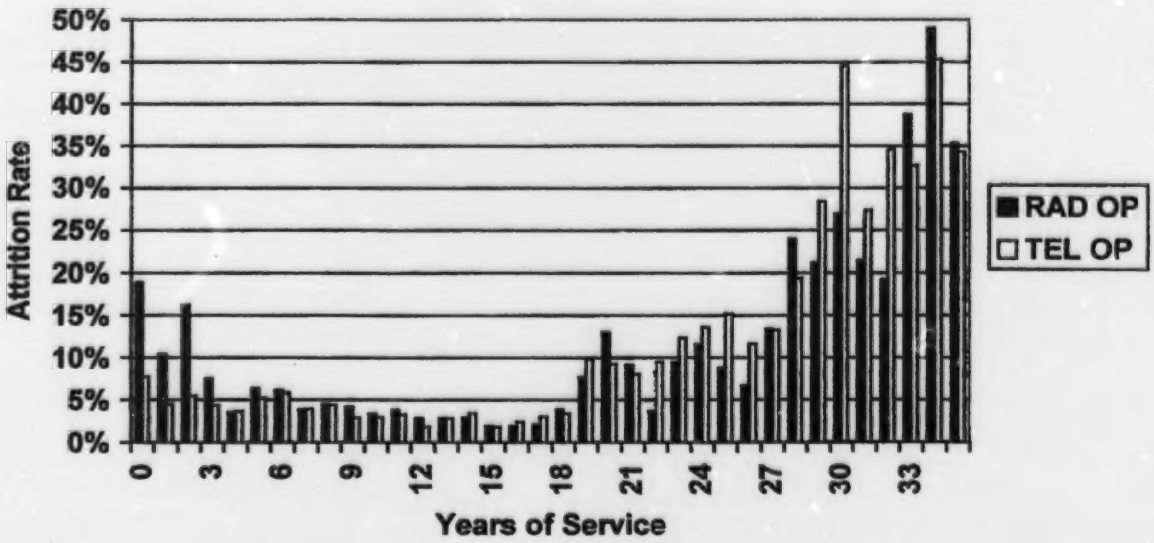

Figure 4: Average Attrition Rates by YOS for all Male Personnel RAD OP (MOC 211) and TEL OP (MOC 212)

Average Attrition Rates of All_212_M and All_212_F

20. Figure 5 compares the historical attrition rates for all male members of the TEL OP (MOC 212) occupation with all female members of the same occupation for calendar years 1982 to 1998. The effect of the FRP can be seen in 1994 and 1995. Statistical tests described in Annex B were applied to this data. However, the results are not significant enough to reject the hypothesis that these two sets of attrition rates have a mean difference of zero. If the 1994 and 1995 data points are removed, the same conclusion is obtained (i.e. the TEL OP attrition rates for all male personnel are not significantly different from TEL OP attrition rates for all female personnel – when the analysis is done by calendar year).

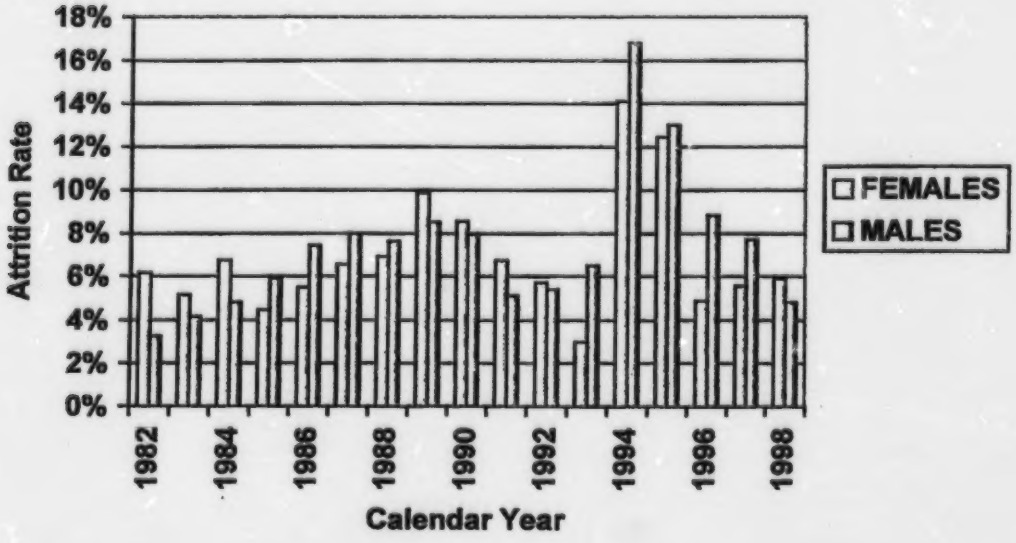

Figure 5: Average Attrition Rates by Year for all Personnel TEL OP (MOC 212) only

21. Figure 6 compares the historical attrition rates by Years of Service for all male and female members of the TEL OP (MOC 212) occupation. Attrition rates for female members are higher at the very lowest experience levels. Attrition variability is high above 20 YOS because of low population sizes. Statistical tests described in Annex B were also applied to this data. As in the case of the "by Year" analysis, the results are not significant enough to reject the hypothesis that these two sets of attrition rates have a mean difference of zero. If "FRP data" from the calendar years 1994 and 1995 are removed, there is no change in this conclusion. However, if the tests are applied to the data for YOS < 19 (with or without the FRP data), the hypothesis that the two sets of attrition rates have a mean difference of zero can be rejected (i.e. TEL OP attrition rates for female personnel exceed TEL OP attrition rates for male personnel for YOS < 19).

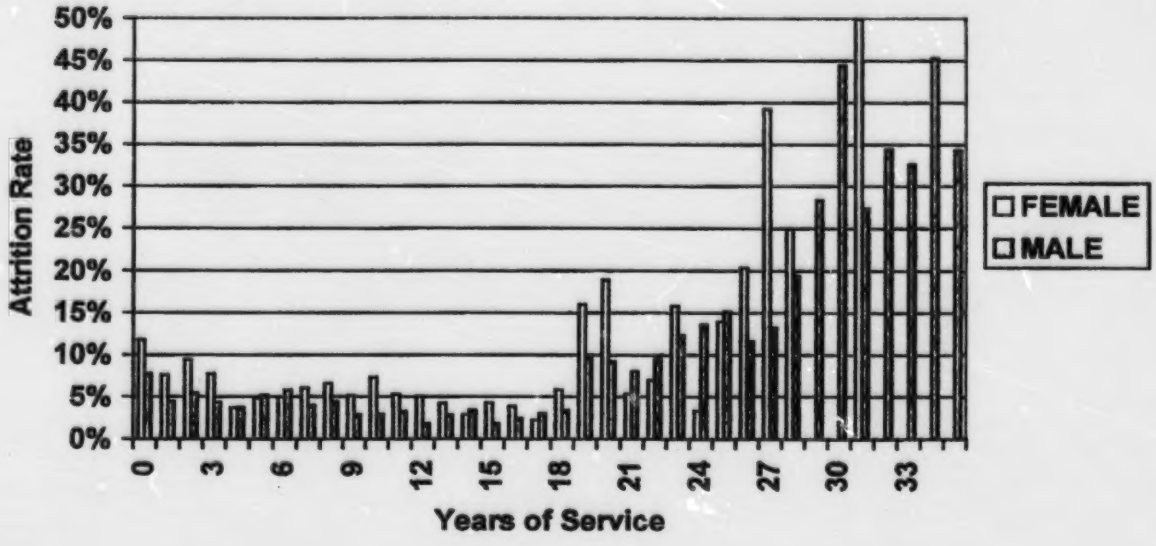

Figure 6: Average Attrition Rates by YOS for all Personnel TEL OP (MOC 212) only

Average Attrition Rates of CPL_212_M and CPL_212_F

22. Figure 7 compares the historical attrition rates for male members of the TEL OP (MOC 212) occupation at the CPL/PTE ranks with all female members of the same occupation and at the same ranks for calendar years 1982 to 1998. Statistical tests described in Annex B were applied to this data. The hypothesis that these two sets of attrition rates have a mean difference of zero can be rejected (i.e. the TEL OP attrition rates for male members at the CPL/PTE ranks are lower than for female members of the same occupation and ranks – when the analysis is done by calendar year). If "FRP data" from the calendar years 1994 and 1995 are removed, there is no change in this conclusion.

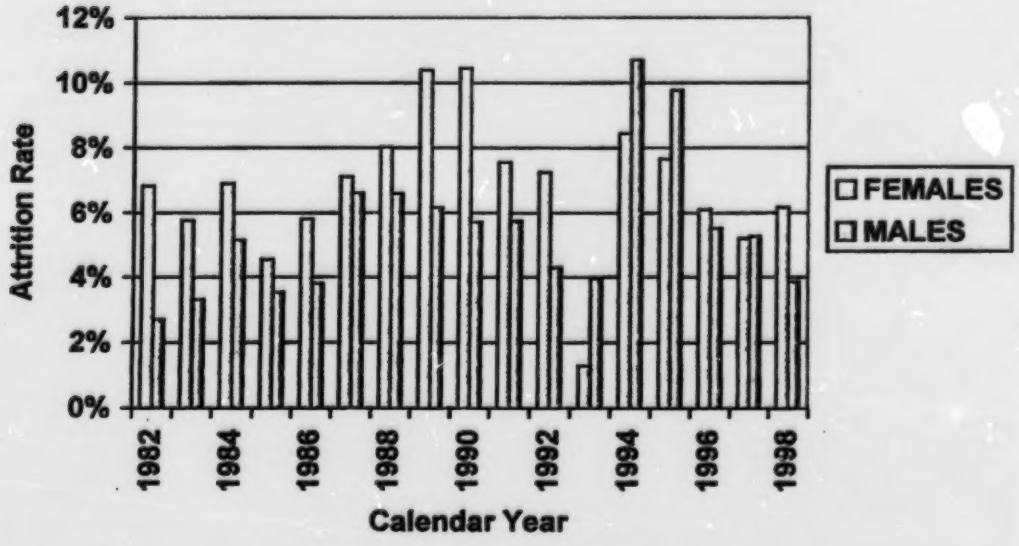

Figure 7: Average Attrition Rates by Year for all Personnel at CPL/PTE TEL OP (MOC 212) only

23. Figure 8 compares the historical attrition rates by Years of Service for all male and female members of the TEL OP (MOC 212) occupation at the CPL/PTE ranks. Attrition rates for high YOS are unreliable because of very small population sizes. It can be seen that attrition rates for female members are higher at the very lowest experience levels. Statistical tests described in Annex B were applied to this data. As in the case of the "by Year" analysis, the hypothesis that these two sets of attrition rates have a mean difference of zero can be rejected (i.e. the TEL OP attrition rates for male members at the CPL/PTE ranks are lower than for female members of the same occupation and ranks – when the analysis is done by YOS < 19).

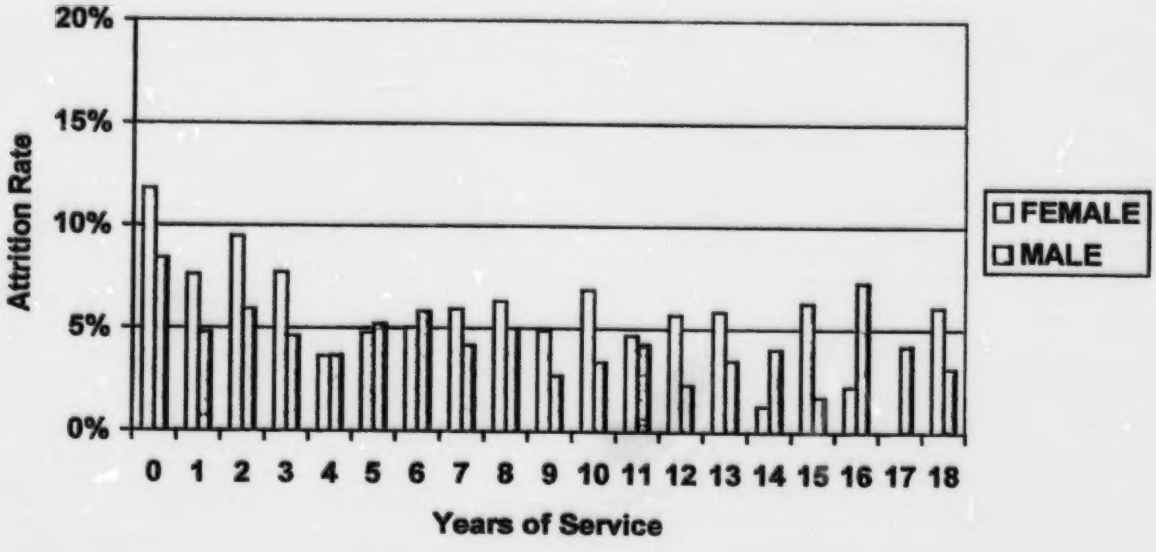

Figure 8: Average Attrition Rates by YOS for all Personnel at CPL/PTE TEL OP (MOC 212) only

Average Attrition Rates of CPL_211_M and CPL_212_M

24. Figure 9 compares the historical attrition rates for male members of the RAD OP (MOC 211) occupation at the CPL/PTE ranks with all male members of the TEL OP (MOC 212) occupation at the same ranks for calendar years 1982 to 1998. Statistical tests described in Annex B were applied to this data. The hypothesis that these two sets of attrition rates have a mean difference of zero can be rejected (i.e. the RAD OP attrition rates for male members at the CPL/PTE ranks are higher than for male members of the TEL OP occupation at the same ranks – when the analysis is done by calendar year). If "FRP data" from the calendar years 1994 and 1995 are removed, the conclusion remains the same.

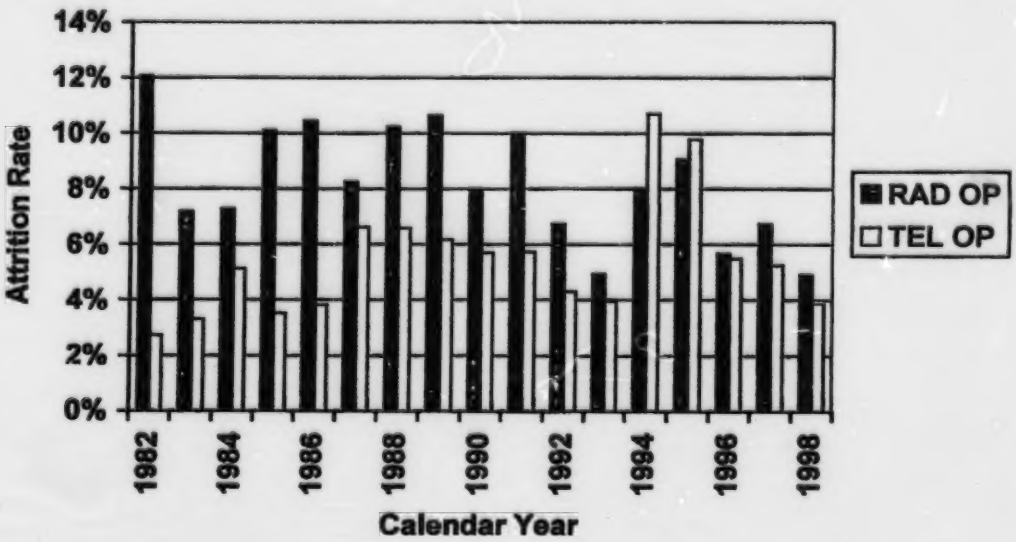

Figure 9: Average Attrition Rates by Year for Male Personnel at CPL/PTE RAD OP (MOC 211) and TEL OP (MOC 212)

25. Figure 10 compares the historical attrition rates by Years of Service for male members of the RAD OP (MOC 211) occupation with male members of the TEL OP (MOC 212) occupation at the CPL/PTE ranks. Attrition rates for high YOS are unreliable because of very small population sizes and have been omitted here. It can be seen that attrition rates for RAD OP members are higher at the very lowest experience levels. Statistical tests described in Annex B were applied to this data. As in the case of the "by Year" analysis, the hypothesis that these two sets of attrition rates have a mean difference of zero can be rejected (i.e. the TEL OP attrition rates for male members at the CPL/PTE ranks are lower than for male members of the RAD OP occupation at the CPL/PTE ranks – when the analysis is done by YOS < 19).

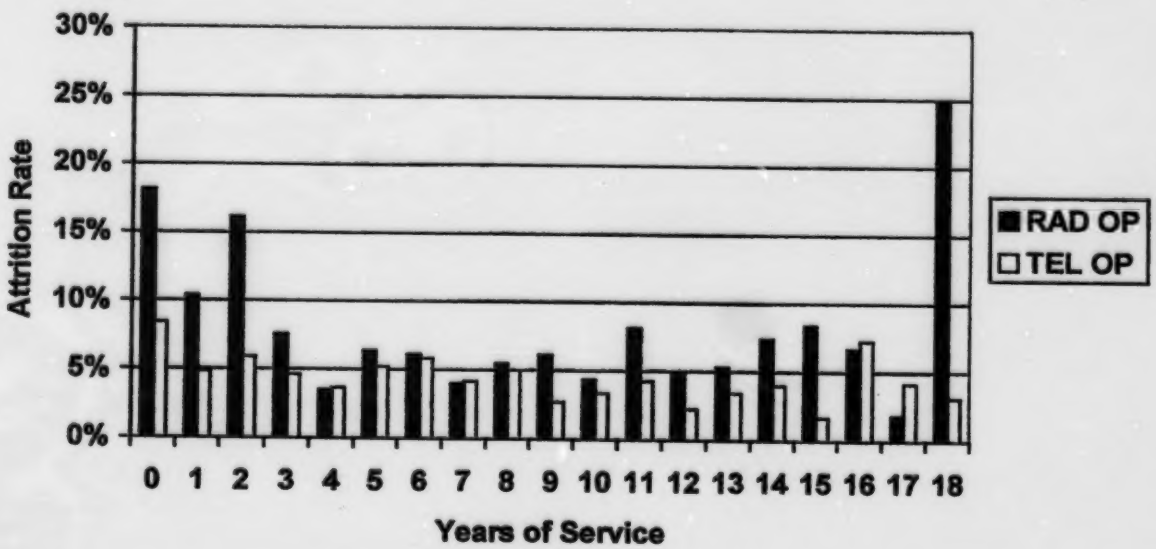

Figure 10: Average Attrition Rates by YOS for male Personnel at CPL/PTE RAD OP MOC 211) and TEL OP (MOC 212)

Average Attrition Rates of MCPL_212_M and MCPL_212_F

26. Figure 11 compares the historical attrition rates for male members of the TEL OP (MOC 212) occupation at the MCPL rank with all female members of the same occupation and at the same rank for calendar years 1982 to 1998. Statistical tests described in Annex B were applied to this data. The hypothesis that these two sets of attrition rates have a mean difference of zero cannot be rejected (i.e. the TEL OP attrition rates for male members at the MCPL rank are not significantly different than for female members of the same occupation and rank – when the analysis is done by calendar year). If "FRP data" from the calendar years 1994 and 1995 are removed, there is no change in this conclusion.

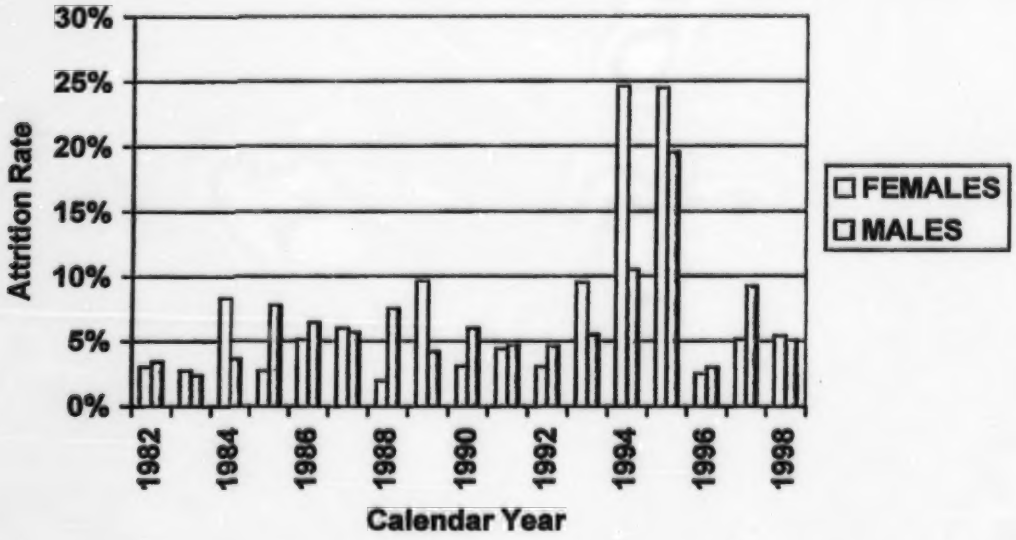

Figure 11: Average Attrition Rates by Year for all Personnel at MCPL TEL OP (MOC 212) only

27. Figure 12 compares the historical attrition rates by Years of Service for all male and female members of the TEL OP (MOC 212) occupation at the MCPL rank. Attrition rates for very high or very low YOS are unreliable because of small population sizes. Statistical tests described in Annex B were applied to this data. In this case, the "by YOS" analysis leads to a different conclusion from the "by Year" analysis. Here, the hypothesis that these two sets of attrition rates have a mean difference of zero can be rejected (i.e. the TEL OP attrition rates for male members at the MCPL rank are lower than for female members of the same occupation and rank – when the analysis is done by YOS). To further complicate this case, when data from FRP years are omitted, the conclusion changes so that the hypothesis then cannot be rejected.

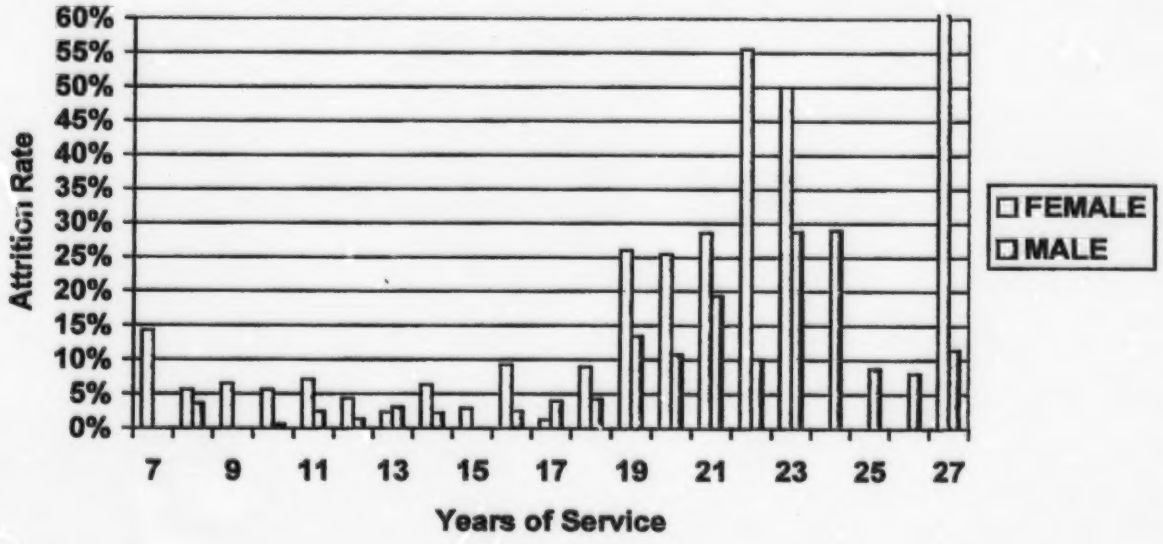

Figure 12: Average Attrition Rates by YOS for all Personnel at CPL/PTE TEL OP (MOC 212) only

Other Attrition Rate Comparisons

28. Small population sizes prevent further tests from being applied reliably to gender-based attrition rate comparisons. However, it is still possible to compare male attrition patterns in the RAD OP and TEL OP occupations by rank. This has been done in Annex B and is summarized below in Table III using the nomenclature introduced previously. (The groups with higher attrition rates are denoted by the ">" symbol.) Population sizes at the MWO and CWO ranks are too small to be included in this analysis.

Table III

Results of Statistical Testing of Male Attrition Rates for RAD OP (MOC 211) and TEL OP (MOC 212) by Rank

ANALYSIS METHOD	WO	SGT	MCPL
By Year	WO_212_M > WO_211_M	SGT_212_M > SGT_211_M	MCPL_212_M > MCPL_211_M
By Year (No FRP)	WO_212_M > WO_211_M	SGT_212_M > SGT_211_M	MCPL_212_M > MCPL_211_M
By YOS	WO_212_M > WO_211_M	SGT_212_M > SGT_211_M	No Conclusion
By YOS (No FRP)	No Conclusion	No Conclusion	No Conclusion
By YOS < 19 (No FRP)	WO_212_M > WO_211_M	No Conclusion	MCPL_211_M > MCPL_212_M

29. It is difficult to draw conclusions about attrition rates for male members at the MCPL rank because the results of different analysis methods disagree. On the other hand, it appears that male only attrition rates for the SGT and WO ranks are higher for the TEL OP occupation than for the RAD OP occupation.

V. SUMMARY AND CONCLUDING REMARKS

30. It is planned that the TEL OP occupation will be deleted by 31 March 2003 with personnel in this occupation encouraged to take an occupational transfer to the RAD OP occupation. PORT has developed a HR model of the RAD OP MOC that takes into account both the current demographic of the "combined" occupation and proposed changes to the MOC. Attrition rates for use in this model were based on the "worst case" assumption that the "higher" historical attrition rates of RAD OP would apply. This paper documents a statistical analysis of historical attrition rates according to rank and gender for the RAD OP and TEL OP occupations. The results from this type of analysis will be used for the development of attrition rates to be used in future RAD OP career flow models. Furthermore, the "lessons learned" from this analysis may be applied to similar studies being carried out by PORT analysts for other clients.

31. A careful analysis of the available historical data has revealed a complex relationship between attrition rates in these two occupations. When the data are all grouped together, little can be concluded because underlying patterns are obscured. These are the "General Conclusions":

a. On a global basis[1], historical attrition rates for RAD OP are higher than for TEL OP, if data from FRP years are not considered;
b. On a global basis[2], historical attrition rates for male personnel are not significantly different between the RAD OP and TEL OP occupations; and
c. On a global basis[2], historical attrition rates for male and female members of the TEL OP occupation are not significantly different.

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[1] amalgamating data for both genders and all ranks and YOS.
[2] amalgamating data for all ranks and YOS.

32. By examining subsets of the data, with and without taking into account FRP years, it is possible to make the following "Specific Conclusions":

a. Historical attrition rates for female members in the TEL OP occupation are higher than for male members of the same occupation at the CPL/PTE ranks and for low YOS;
b. Historical attrition rates for male members of the RAD OP occupation are higher than for male members of the TEL OP occupation at the CPL/PTE ranks and for low YOS;
c. Statistical tests applied to the comparison of historical attrition rates for male and female members in the TEL OP occupation are inconclusive at the MCPL rank; and
d. Historical attrition rates for the RAD OP occupation are lower than for the TEL OP occupation at the SGT and WO ranks and for high YOS.

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ANNEX A to
DOR(CAM) Research Note RN-9913
Dated August 1999

POPULATION DATA:
RAD OP (MOC 211) and TEL OP (MOC 212)

A1. This Annex contains the "raw" population data for the two occupations being analyzed in this paper. The information was extracted from the PORT strategic desktop computer database [2] covering the period from 1982 to 1996 as well as from a new Peoplesoft "datamart" NCM release download for 1996 to 1999.

A2. Tables A-I and A-II contain "snapshots" of the population data for MOCs 211 and 212 respectively summed by gender and rank for April of the calendar years 1982 to 1998. These tables aggregate all years of service (YOS).

Table A-I

Historical Population Data for RAD OP (MOC 211) *

by Calendar Year and Gender

YEAR	CWO		MWO		WO		SGT		MCPL		CPL		PTE (B)	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1998	12	0	32	0	61	0	125	0	269	0	438	26	76	19
1997	15	0	35	0	66	0	131	0	280	0	472	28	78	19
1996	18	0	39	0	78	0	133	0	293	0	496	26	74	14
1995	21	0	40	0	86	1	143	1	318	0	544	31	49	11
1994	26	0	45	0	88	1	158	1	324	0	630	27	45	5
1993	28	0	45	0	87	1	161	1	358	0	556	18	51	4
1992	27	0	46	0	93	1	178	1	368	0	481	14	159	27
1991	30	0	40	0	92	1	177	2	374	0	490	2	244	37
1990	26	0	40	0	97	1	177	2	375	1	470	1	274	54
1989	25	0	35	0	92	1	174	2	376	1	451	0	350	45
1988	27	0	33	0	86	0	174	3	360	1	478	0	355	11
1987	28	0	29	0	83	0	178	3	349	1	460	0	356	2
1986	-	-	-	-	-	-	171	3	347	2	396	0	337	2
1985	-	-	-	-	-	-	168	2	332	3	363	0	459	1
1984	-	-	-	-	-	-	172	2	332	5	308	0	529	0
1983	-	-	-	-	-	-	164	2	322	5	259	0	487	0
1982	-	-	-	-	-	-	156	3	318	3	170	2	457	0

* This table does not include cases where the rank and/or gender were missing from the database. Data for the ranks PTE(R), i.e. Private (Recruit) and PTE(T), i.e. Private (Trained) are omitted here because of limited space. These data were included in the analysis.

Table A-II

Historical Population Data for TEL OP (MOC 212) *

by Calendar Year and Gender

YEAR	CWO		MWO		WO		SGT		MCPL		CPL		PTE (B)	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1998	4	2	10	2	20	6	60	27	59	37	179	145		
1997	7	2	10	3	23	8	66	27	65	39	189	153		
1996	9	2	12	3	28	8	79	28	67	40	199	163		
1995	11	2	13	3	36	10	87	32	82	49	188	167		
1994	14	1	16	3	44	8	97	38	105	61	201	181	23	7
1993	14	0	18	3	44	8	96	28	109	63	201	167	66	28
1992	13	0	19	2	44	8	104	23	108	66	188	149	56	53
1991	14	0	16	3	47	8	102	23	107	67	179	139	72	81
1990	16	0	18	1	45	8	106	19	117	64	183	144	43	63
1989	15	0	18	0	45	8	114	15	118	60	203	147	34	58
1988	12	0	20	0	50	4	115	16	132	49	207	163	37	60
1987	9	0	24	0	57	4	118	15	140	50	218	143	49	90
1986	-	-	-	-	-	-	132	13	156	39	202	151	35	81
1985	-	-	-	-	-	-	139	14	167	37	188	135	64	90
1984	-	-	-	-	-	-	144	12	166	36	197	131	58	62
1983	-	-	-	-	-	-	153	9	170	36	193	119	75	72
1982	-	-	-	-	-	-	149	7	173	33	211	112	61	87

* This table does not include cases where the rank and/or gender were missing from the database. Data for the ranks PTE(R), i.e. Private (Recruit) and PTE(T), i.e. Private (Trained) are omitted here because of limited space. These data were included in the analysis.

ANNEX B to
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STATISTICAL TESTS

B1. This Annex describes the statistical tests employed in this paper together with the results obtained in the analyses. The results were obtained using the Statistical Analysis System (SAS) and are reported below in tabular form.

B2. The following group nomenclature is used in this paper:

a. All_211_All: all data for MOC 211;
b. All_212_All: all data for MOC 212;
c. All_211_M: all data for male personnel in MOC 211;
d. All_211_F: all data for female personnel in MOC 211;
e. All_212_M: all data for male personnel in MOC 212;
f. All_212_F: all data for female personnel in MOC 212;
g. CPL_211_M: all data for male Corporals in MOC 211 (including personnel at the Private rank);
h. CPL_211_F: all data for female Corporals in MOC 211 (including personnel at the Private rank);
i. CPL_212_M: all data for male Corporals in MOC 212 (including personnel at the Private rank);
j. CPL_212_F: all data for female Corporals in MOC 212 (including personnel at the Private rank);
k. MCPL_211_M: all data for male Master Corporals in MOC 211;
l. MCPL_211_F: all data for male Master Corporals in MOC 211;

etc.

TEST FOR INDEPENDENCE

B3. This paper compares two sets of attrition rates to determine whether or not they are equal. As most statistical tests require the assumption of independence, it was appropriate to test the hypothesis that "corresponding" sets of attrition rates could be treated as independent random samples. The "Chi-Square Test for Equal Proportions" was used to test this hypothesis with the results displayed in Table B-I. "STAT" is used to represent the statistic obtained, "DF" refers to the degrees of freedom of the chi-square variable, and "PROB" is the p-value obtained in the test. A value of (say) p=0.05 would reasonably allow acceptance of the hypothesis that the two datasets are independent. Thus for each pair of data sets tested there was not enough evidence to reject the null hypothesis of independence, whether the group attrition rates were compared by calendar year or by YOS. Unfortunately, the validity of the test used was questionable. Consequently, the results of statistical tests that require independent data cannot be assured.

Table B-I

Test of Independence

(Chi-Square Test for Equal Proportions used to test whether or not two data sets are independent)

Test	Method					
	by Year			by YOS		
	STAT	DF	PROB	STAT	DF	PROB
All_211_All and All_212_All	0.003	1	0.955	0.124	1	0.725
All_211_M and All_212_M	0.000	1	0.988	0.823	1	0.364
All_212_M and All_212_F	0.002	1	0.961	0.109	1	0.741
CPL_211_M and CPL_212_M	0.096	1	0.076	0.003	1	0.355
CPL_212_M and CPL_212_F	0.025	1	0.875	0.668	1	0.414
MCPL_211_M and MCPL_212_M	0.044	1	0.833	0.206	1	0.650
MCPL_212_M and MCPL_212_F	0.007	1	0.934	0.000	1	0.984
SGT_211_M and SGT_212_M	0.171	1	0.679	0.001	1	0.970
WO_211_M and WO_212_M	0.075	1	0.784	0.000	1	0.982

TEST FOR NORMALITY

B4. To test whether or not the attrition data are drawn from a normal distribution the "Shapiro–Wilks Test" was applied to each group of data. The results are displayed in Table B-II (by calendar year) and B-III (by Years of Service). The p-value is for an upper tailed test and the symbol "n/s" is used to indicate that the result was not significant enough to reject the hypothesis of normal distribution. It may be concluded that the data do not represent samples from normal distributions. Thus the "Paired-Comparison t-Test" was chosen for the next set of statistical tests (discussed in the next section of this Annex) as it does not require independent data and, like any t-Test, it is robust and adaptable to deviations from normality.

Table B-II

Test for Normality by Calendar Year

(Shapiro-Wilks Test for the hypothesis that the data represent samples from a normal distribution)

GROUP	p-value	CONCLUSION
CPL_211_M	0.59170	n/s
CPL_212_F	0.27900	n/s
CPL_212_M	0.03070	not normal
MCPL_211_M	0.01330	not normal
MCPL_212_F	0.00002	not normal
MCPL_212_M	0.00050	not normal
SGT_211_M	0.00007	not normal
SGT_212_M	0.08430	n/s
WO_211_M	0.00030	not normal
WO_212_M	0.07540	n/s

Table B-III

Test for Normality by Years of Service < 19

(Shapiro-Wilks Test for the hypothesis that the data represent samples from a normal distribution)

GROUP	p-value	CONCLUSION
CPL_211_M	0.0036	not normal
CPL_212_F	0.6284	n/s
CPL_212_M	0.6187	n/s
MCPL_211_M	0.2613	n/s
MCPL_212_F	0.0002	not normal
MCPL_212_M	0.7021	n/s
SGT_211_M	0.0586	n/s
SGT_212_M	0.0214	not normal
WO_211_M	0.0968	n/s
WO_212_M	0.2756	n/s

TEST FOR ZERO MEAN DIFFERENCE

B5. A "Paired-Comparison t-Test" was chosen for this test as it does not require independent data and, like any t-Test, it is robust with respect to deviations from normality. For this test, data had to be paired in such way that if an observation in one set was missing or not being considered, a parallel observation in the other set (i.e., one which was observed in the same Year or YOS as the missing one) had to be omitted. Then a difference variable was created for each pair of the parallel data in such way that a positive value would indicate that the attrition rates agree with the assumptions being tested, negative value that they disagree and zero value that the rates are equal. As a result the procedure of comparing the attrition rates coming from two sets of data is reduced to a one sample hypothesis test with the null hypothesis that the mean difference is zero.

B6. The results from the application of the Paired t-Tests are shown in Tables B-IV for tests based on calendar year and B-V and B-VI for tests based on Years of Service. The symbol "T" is used to represent the test statistic obtained, "μ_{diff}" represents the mean difference variable, and "n/s" indicates that the result of applying the test is not significant enough to reject the hypothesis. The minimal p-values for each test are displayed in bold font.

Table B-IV

Test for Zero Mean Difference by Year

(Paired t-Test for the null hypothesis that the mean difference between the attrition rate of two populations is zero)

GROUP	T	P –value			CONCLUSION
		$\mu_{diff} <> 0$	$\mu_{diff} < 0$	$\mu_{diff} > 0$	
All_211_All and All_212_All	1.1456	0.2688	0.8656	**0.1344**	n/s
All_211_M and All_212_M	0.2615	0.7971	0.6015	**0.3986**	n/s
All_212_M and All_212_F	-0.7665	0.4546	**0.2273**	0.7727	n/s
CPL_211_M and CPL_212_M	3.9051	0.0013	0.9994	**0.0007**	M211 > M212
CPL_212_M and CPL_212_F	2.5033	0.0235	0.9883	**0.0118**	F212 > M212
MCPL_211_M and MCPL_212_M	-2.425	0.0275	**0.0138**	0.9863	M211 < M212
MCPL_212_M and MCPL_212_F	0.6366	0.5334	0.7333	**0.2667**	n/s
SGT_211_M and SGT_212_M	-3.5997	0.0024	**0.0012**	0.9988	M211 < M212
WO_211_M and WO_212_M	-2.9609	0.0130	**0.0065**	0.9935	M211 < M212

Table B-V

Test for Zero Mean Difference by Years of Service

(Paired t-Test: null hypothesis that the mean attrition rate difference = 0)

GROUP	T	P –value			CONCLUSION
		$\mu_{diff} <> 0$	$\mu_{diff} < 0$	$\mu_{diff} > 0$	
All_211_All & All_212_All	-1.1337	0.2642	**0.1321**	0.8679	n/s
All_211_M & All_212_M	-0.9152	0.3660	**0.1830**	0.8170	n/s
All_212_M & All_212_F	-0.0768	0.9393	**0.4697**	0.5304	n/s
CPL_211_M & CPL_212_M	-0.525	0.6036	**0.3018**	0.6982	n/s
CPL_212_M & CPL_212_F	-0.0592	0.9532	**0.4766**	0.5234	n/s
MCPL_211_M & MCPL_212_M	-0.3102	0.7588	**0.3794**	0.6206	n/s
MCPL_212_M & MCPL_212_F	1.874	0.0749	0.9626	**0.0375**	F212 > M212
SGT_211_M & SGT_212_M	-2.2849	0.0315	**0.0158**	0.9843	M211 < M212
WO_211_M & WO_212_M	-1.6586	0.1121	**0.0561**	0.9440	M211 < M212

Table B-VI

Test for Zero Mean Difference by Years of Service <19

(Paired t-Test: null hypothesis that the mean attrition rate difference = 0)

GROUP	T	P –value			CONCLUSION
		$\mu_{diff} <> 0$	$\mu_{diff} < 0$	$\mu_{diff} > 0$	
All_211_All and All_212_All	1.3791	0.1848	0.9076	**0.0924**	n/s
All_211_M & All_212_M	2.1807	0.0427	0.9787	**0.0214**	M211 > M212
All_212_M & All_212_F	4.8304	0.0001	0.99995	**0.00005**	F212 > M212
CPL_211_M & CPL_212_M	3.4145	0.0033	0.9984	**0.0017**	M211 > M212
CPL_212_M & CPL_212_F	1.8411	0.0821	0.9590	**0.0411**	F212 > M212
MCPL_211_M & MCPL_212_M	2.2439	0.0415	0.9793	**0.0208**	M211 > M212
MCPL_212_M & MCPL_212_F	3.3247	0.0061	0.9970	**0.0031**	F212 > M212
SGT_211_M & SGT_212_M	-2.3756	0.0288	**0.0144**	0.9856	M211 < M212
WO_211_M & WO_212_M	-1.6402	0.1183	**0.0592**	0.9409	M211 < M212

B7. The above statistical tests allow several conclusions to be drawn. For tests involving the "entire populations" of the RAD OP and TEL OP occupations, there is no statistically significant difference between the attrition rates observed. ("Entire population" is taken to include data for all ranks, both genders, across calendar years 1982 to 1998 and for all Years of Service.)

B8. For male personnel only (all ranks combined), it is not possible to conclude that the attrition rates are different between these two occupations. It was not possible to compare female attrition rates between the two occupations because of small numbers of female personnel in the RAD OP (MOC 211) occupation. For junior ranks (CPL/PTE), attrition is higher for RAD OP (MOC 211) than it is for TEL OP (MOC 212) for male personnel. This reverses for the SGT and WO ranks, where attrition for male personnel is higher for the TEL OP (MOC 212) occupation than it is for RAD OP (MOC 211).

B9. Within the TEL OP occupation it is possible to compare male and female attrition patterns. It may be concluded that male attrition rates at the CPL/PTE ranks are lower than the corresponding female attrition rates. Statistical tests applied to data at the MCPL rank are inconclusive.

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1. ORIGINATOR (the name and address of the organization preparing the document. Organizations for whom the document was prepared e.g. Establishment Sponsoring a contractor's report, or tasking agency, are entered in Section 8).

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2. SECURITY CLASSIFICATION (overall security classification of the document, including special warning terms if applicable)

Unclassified

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title)

A Comparative Analysis of Attrition Rates in the Radio and Teletype Operator Occupations by Rank and Gender (U)

4. AUTHORS (last name, first name, middle initial)

Jesion, Dr A., and Winiszewska, M.

5. DATE OF PUBLICATION (month Year of Publication of document)	6a. NO OF PAGES (total containing information. Include Annexes, Appendices, etc.)	6b. NO OF REFS (total cited in document)
August 1999	31	8

7. DESCRIPTIVE NOTES (the category of document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

Research Note

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address).

Chief of Staff, Assistant Deputy Minister Human Resources Military

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NIL	NIL

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The Teletype Operator (TEL OP) Occupation is scheduled to be deleted by 31 March 2003 with personnel in this occupation encouraged to take an occupational transfer to the Radio Operator (RAD OP) occupation. The Personnel Operational Research Team (PORT) has developed a career flow model of the RAD OP occupation that takes into account both current population demographics and proposed policy changes. Attrition rates for use in this model were based on the "worst case" assumption that the "higher" historical attrition rates of RAD OP would apply. This paper documents a statistical analysis of historical attrition rates according to rank, years of service and gender for the RAD OP and TEL OP occupations.

A careful analysis of the available historical data has revealed a complex relationship between attrition rates in these two occupations. When the data are all grouped together, little can be concluded because underlying patterns are obscured. It can be demonstrated that historical attrition rates for the RAD OP occupation are "higher" than for the TEL OP occupation, but this effect is concentrated at the lower ranks and experience levels. At ranks above Master Corporal, TEL OP attrition rates are higher. Also, a number of gender-based attrition comparisons have been made within the TEL OP occupation as it has significantly more female members than the RAD OP occupation. Here, it is shown that historical attrition rates for male and female members are not significantly different, except at the lower ranks and experience levels where female attrition rates are higher.

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